12-2004

Applying Information Technology To Decision-Making: The EPA GeoBook Applied To Greenway Planning

Margaret Ann Ely
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Margaret Ann Ely entitled "Applying Information Technology To Decision-Making: The EPA GeoBook Applied To Greenway Planning." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Architecture.

John Peine, Major Professor

We have read this thesis and recommend its acceptance:

Tim Ezzell, Edward Jepson

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Studies

Applying Information Technology To Decision-Making: The EPA GeoBook Applied To Greenway Planning

A Thesis
Presented for the
Master of Science in Planning
Degree
The University of Tennessee, Knoxville

Margaret Ann Ely
December 2004

Dedication

This thesis is dedicated to my family, who give me the confidence to be the woman I know to be.

Acknowledgements

I wish to thank all those who have supported me in my efforts to obtain the Master of Science degree in Urban Planning. I would especially like to thank Dr. John Peine for all of his help and guidance during the process of writing this thesis and for his willingness to serve as my committee chair. I thank Dr. Tim Ezzell for always making me look forward to work and for his insight as he served on my committee. I would like to thank Dr. Edward Jepson for serving on my committee. I particularly would like to thank Rick Durbrow, Program Analyst US EPA Region IV, for all the help he provided in my explorations of the GeoBook.

Finally, I sincerely thank those who, in the past two years, were an absolute pleasure to labor alongside, my fellow planners and my friends: Tamara Harrison, Melany Noltenius, and Micah Wood.

Abstract

The purpose of this thesis is to examine the role information technology could play in the planning process, by studying the role GeoBook played in its application to greenway planning. Technology has continued to advance through the years, so it is important that the planning process incorporates these technologies so as to become more proficient at making decisions. Because our natural resources are limited, we have the responsibility to steward them to the best of our ability and to make the most educated decisions possible. By incorporating modern science into land-use decisions, decision-makers can make more informed decision. This thesis examines the background of the GeoBook and its capabilities, followed by a look at the GeoBook's role in the French Broad Blueway. I chose to study the GeoBook because habitat fragmentation is the number one threat to ecosystem biodiversity and health. Ecosystems cannot survive in isolation, and the Southeastern Ecological Framework is a system that can combat this threat.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

Purpose of the Study

The purpose of this thesis is to evaluate the utility of the information system entitled GeoBook, a program created by the University of Florida in conjunction with the United States Environmental Protection Agency (USEPA) Region IV, in the context of a specific planning process.

Scope of Research

Edward O. Wilson, Ph.D, Socio-Biologist, addressed the National Press Club Luncheon on April 19, 2004 on the topic, The Future of Life. During his speech he identified species fragmentation as a major threat to species richness and biodiversity. He acknowledged the creation of corridors as a means of removing the isolation currently being forced upon many ecosystems. The following quote comes from the Dr. Wilson's speech, "America's species…are trapped in reserves. And even if they somehow could move north, they can't because they're surrounded by farmland or degraded forest or other disturbed habitats. So the solution to this problem… is to pay more attention to the design of natural reserves that are oriented north and south. They're called corridors."

This quote sums up the reason I chose to work with GeoBook, an information technology system that incorporates a science that addresses this problem.

This research concentrates on an ecological analysis applied to greenways planning, utilizing only ecological databases. Some inherent limitations are built into this type of analysis. Looking solely at the usefulness of one tool, the GeoBook, and applying this study to one application, greenway planning, provides a limited perspective on the usefulness of information technology and its application in the general field of planning. However, this research is narrow enough in scope to complete an analysis of the utility of widely available information technology to the planning process. The study area applied to this evaluation follows the greenway corridor of the French Broad River, with specific focus on the Knox County region. The database and maps applied to the study area are from the GeoBook. Although greenways are often associated with linear recreational features such as rails-to-trails, this concept includes wildlife corridors, landscape linkages, and landscape-level conservation areas within an ecological network connecting public and private conservation lands across the state. The definition of a greenway may vary, so a working definition that will be applied to this study comes from the Pennsylvania Greenways Partnership and is as follows:

> A greenway is a corridor of open space. Greenways vary greatly in scale, from narrow ribbons of green that run through urban, suburban, and rural areas to wider corridors that incorporate diverse natural, cultural and scenic features. They can incorporate both public and private property, and can be land-or water-based. They may follow old railways, canals, or ridge tops, or they may follow stream corridors, shorelines, or wetlands, and include water trails for non-motorized craft. Some

> greenways are recreational corridors or scenic byways that may accommodate motorized and non-motorized vehicles. Others function almost exclusively for environmental protection and are not designed for human passage. Greenways differ in their location and function, but overall, a greenway will protect natural, cultural, and scenic resources, provide recreational benefits, enhance natural beauty and quality of life in neighborhoods and communities, and stimulate economic development opportunities (Pennsylvania Environmental Council, 1998).

Those involved in the planning process for the French Broad River Corridor refer to this area as a blueway to denote that it is situated on a river.

Background

Habitat fragmentation is the number one threat to ecosystem biodiversity and health. Ecosystems cannot survive in isolation (Berish, et al, 1999). Additionally, greenspace protection has increasingly become important to citizens. In 1998, 124 state and local open space protection referenda were passed on the November ballot (Land Trust Alliance, 1999). It is logical to combine a method for alleviating habitat fragmentation with open space preservation. Local decision-makers are developing comprehensive plans that balance habitat protection, water and air quality, and economic growth within their communities. To achieve this, planners and decision-makers need to be suited with the best available information. The remainder of this chapter will document the progressions made that lead to the formation of the GeoBook. The first program is the Southern Appalachian Assessment, followed by the Southeastern Ecological Framework and ending with the GeoBook.

The Southeastern Ecological Framework (SEF) grew out of the experience of the Southern Appalachian Assessment (SAA). The SAA was designed to carefully examine what is known about the Appalachian region's ecosystem and its air, water, and land resources in hopes to identify the major threats to the area so that they may be disarmed before they endangered the health of other natural resources. It is an ecological assessment based on natural boundaries rather than political boundaries. The Southern Appalachian Man and Biosphere (SAMAB) coordinated the SAA while a cooperative was formed between the following agencies: the United States (U.S.) Department of Agriculture, Forest Service; Tennessee Valley Authority; U.S. Environmental Protection Agency; U.S. Department of the Interior, Geological Survey, National Park Service, National Biological Service, Fish and Wildlife Service; Appalachian Regional Commission; U.S. Army Corps of Engineers; Georgia Department of Natural Resources; North Carolina Department of Environment, Health, and Natural Resources; Tennessee Department of Environment, Health, and Natural Resources; Tennessee Department of Environment and Conservation; U.S. Department of Commerce, Economic Development Administration; and the U.S. Department of Energy, Oak Ridge National Laboratory. The significance of this cooperative is these different agencies labored together, without duplicating work, to expand the scope and depth of analysis performed.

The scientist with the responsibility of conducting the SAA used the best technology available at the time to gather and interpret large quantities of data about the region. The results of the study presented the present condition and trends of the area with the potential consequences of those trends. The results are available via five reports

or in the form of geographic information system (GIS) data. To make this information more widely accessible to users it was made available using the Internet as well as traditional printed form. The assessment is meant to give people the information needed to have a productive discussion of the problems and allow the solutions to be made in the political process by all (Berish, et al, 1999). While this assessment focused on the management of public land, it was noted that decisions made at the private land-owner level is the most foremost determinate of the health and appearance of most of he region's ecosystems because 87.3 percent of the land is in private ownership (Southern Appalachian Man and the Biosphere, 1996).

The SAA and its databases received a vice-presidential Hammer Award and are hailed as examples of effective interagency collaboration. The SAA was encouraged to be used in public and private decision making at all levels. However, the SAA lacks accessibility to be applied to problem solving so the Southeastern Ecological Framework (SEF) was generated to focus on the over arching issue of connectivity of protected areas within a biome via viable corridors, ergo the development of a framework. The SEF began in October of 1998 by staff of the Planning and Analysis Branch in EPA Region IV and researchers at the University of Florida and with its completion in December 2001. The development of the SEF by the University of Florida was based on their experience in the creation of the Florida Ecological Network (FEN) for the state of Florida. Florida adopted the concept of an integrated habitat network as part of the Florida Greenways Program in 1992. Although greenways are often associated with linear recreational features such as rails-to-trails, the Florida concept did not limit itself to

this ideal. The types of greenways used were wildlife corridors, landscape linkages, and landscape-level conservation areas within an ecological network to connect public and private conservation lands across the entire state. The SEF Project is a GIS-based analysis whose purpose is to identify ecologically significant areas and connectivity in the southeast region of the United States. The states located in EPA Region IV include Florida, Georgia, Alabama, Mississippi, South Carolina, North Carolina, Tennessee and Kentucky. The diversity of these eight states is extraordinary, ranging from the coastal plain to the piedmont, from the Mississippi Delta to the plateaus of Tennessee and Kentucky, and includes exquisite coral reefs, the world's third oldest river, the French Broad River, and the oldest mountains in the world, the Appalachian Mountains.

The SEF specifically is a "decision support tool created through systematic landscape analysis of ecological significance and the identification of critical landscape linkages in a way that can be replicated, enhanced with new data, and applied at different scales" (Berish, 1999). The goal of the SEF is to create a comprehensive effort to conserve the resources in EPA Region IV with the big picture perspective. The SEF integrates dozens of complex environmental parameters into one useful tool. It also allows decision makers to prioritize and protect ecologically significant resources before major decisions are made in the planning process. The SEF can play a key role in helping federal and state agencies, local governments, non-profit organizations and the public make coordinated natural resource conservation decisions that provide co-benefits for local and regional ecosystem services protection. The SEF's role is essential because it crosses the boundaries between states to take a regional view. Fragmentation of the

landscape is the greatest threat to a properly functioning ecosystem (Harris, 1984). Unfragmented natural areas provide the cornerstone of the SEF (Durbrow, 2002). The SEF model locates important hubs, defined in ecological terms, and identifies passageways, or corridors, that interconnects the hubs. For an area to obtain the classification of a hub, it must be of an ample size with high plant and animal diversity, little fragmentation, support rare species, have important waterways and few or no roads. These hubs often are located in wildlife refuges, parks, national forests, or private protected lands. The passageways typically follow natural landforms and water features.

The great push for conservation of this region exists for many reasons. First of all, six of the top ten states identified nationwide as having the highest risk of biotic impoverishment are located within this region (Noss and Peters, 1995). The states are Florida, Georgia, North Carolina, South Carolina, Alabama, and Tennessee. Continual habitat loss and fragmentation have reduced the historical natural state of the area as well as the removal of natural forest types and alterations in the river systems. Another pressing threat is the increase in urbanization in the southeastern United States (Berish, 1999). The EPA's mission, "to protect human health and to safeguard the natural environment- air, water, and land- upon which life depends" requires them to address this topic (History, 2004). Pressures on ever shrinking eco-systems to sustain an increasing number of humans are reducing the quality of the environment and the likelihood of sustainability. EPA Region IV's concern for limited resources has inspired it to attempt to prioritize natural resources, thus the creation of the SEF. The SEF attempts to mend habitat fragmentation by identifying areas of conservation significance at a regional scale

and creating links. The SEF is a region-wide assessment of areas critical for conserving natural resources.

Information technology has been identified as a valuable resource in the planning process. Using visualization techniques such as GIS have been documented to enhance public participation in the planning process because it allows technical and non-technical participants to related to the information (Al-Kodmany, 1999). The drawbacks of using information technology, specifically GIS, in the planning process are the detailed data needed is quite extensive and the included cost of GIS training and equipment can also be impractical (Hoch, 2000). The GeoBook was formed from the SEF data. The GeoBook is a computer application that contains pages of information on the SEF, a short video, a PowerPoint presentation, and a map viewer. It is specifically designed to allow those who are involved in watershed or ecosystem protection and do not have access to GIS data or the training and experience required to use GIS software to access and apply in various combinations of GIS configured data layers. In short, the GeoBook maps are like snapshots of GIS created maps that actively allow the user to turn layers on and off. The purpose of this tool is to allow the user to identify ecologically sensitive areas, or lands that are in need of conserving. This allows local users to make choices to conserve land in their area that will benefit the overall environmental health in a regional context.

The goal of the EPA Region IV is to have the GeoBook available to all people via the World Wide Web. "The GeoBook is an intermediate product that will eventually evolve into a web based application that integrates with the Office of Environmental

Information's strategy of providing desktop access to EPA's databases in a user friendly environment" (Science Inventory, 2004). Because most people are unfamiliar with the scientific acronyms or phrases used in scientific literature, it is important that the GeoBook is fashioned in a way that provides all types of users with equal opportunity to take advantages of the information. To accomplish this the GeoBook links the data layers to sources of additional information available on the Internet. Figure 1 gives an example of what the GeoBook would like on someone's computer screen.

The GeoBook can easily be applied to the study of greenways since it identifies linear corridors of space, which are typically the shape greenways follow. In turn, this is

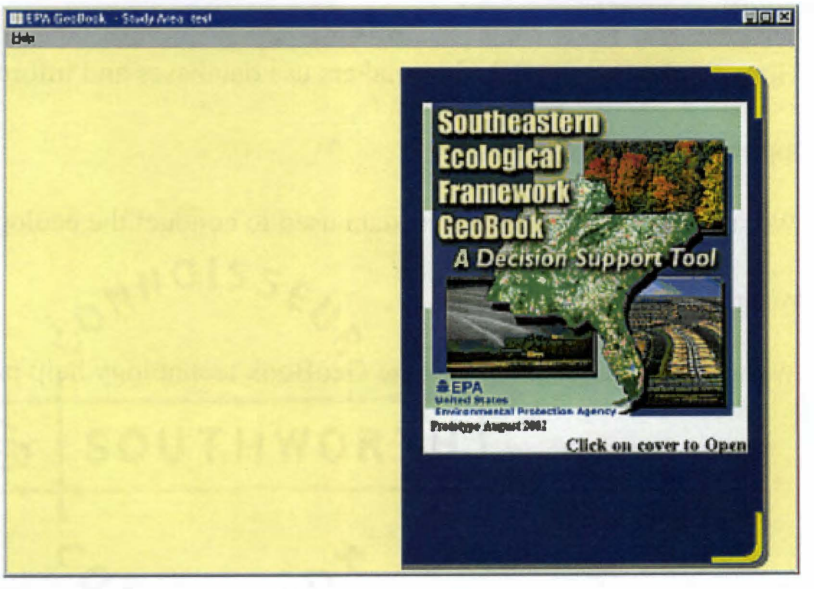

FIGURE 1. SNAPSHOT OF GEOBOOK'S BOOK-LIKE FORMAT

a great way to actually create links to the hubs identified in the SEF. The intention of the EPA Region IV's GeoBook is to support the local decision-making process for the protection of green space by using a web based GIS data viewer (Johnson, 2003). This thesis will evaluate the GeoBook in the framework of creating the French Broad River Blueway.

Research Questions

Primary Question

- How useful are the databases and the way they are assembled and accessed in GeoBook to the process of planning for the creation of greenways?

Secondary Questions

- How do planner and decision-makers use databases and information technology as applied to greenway planning?
- What are the limitations of the data used to conduct the ecological analysis during greenway planning?
- What types of decisions does the GeoBook technology help planners make?

CHAPTER 2

METHODOLOGY

Given the practical nature of this thesis topic, supporting evidence will primarily rely on observations of those applying the GeoBook databases in greenway planning, as well as its application out in the field. Preferably, the evaluator would have an extensive understanding of the issues facing the project, the entire decision-making process, all of the involved sciences, and knowledge of possible other technologies that relate to the process. An evaluator with an extensive knowledge of all these subjects is a rarity; therefore a methodology has been constructed so the evaluator is not required to be an expert on all of these topics. An underlying assumption of this methodology is that each planning and decision-making process is unique with individually goals and concerns.

Methodology Components

The evaluation methodology consists of five main categories:

1. Issue of concern,
2. Characteristics of the planning and decision-making process,
3. Relevance of information technology to the issue,
4. Capabilities of the GeoBook,
5. And impact of the information technology.

The remainder of this chapter is dedicated to giving a description of the elements that are the five categories of this evaluation methodology along with some techniques used to collect these types of information.

Issue of Concern

To begin any evaluation the first step should be a clear identification of the issue at hand. In the course of issue identification, it is relevant to ascertain where the origin of concern has come from. For instance, this may be a governmental agency, the public, scientists, or a land trust. The next step would be to determine how the issue relates to the overall goal of the area.

Characteristics of the Planning and Decision-Making Process

The goals of the planning and decision making process are essential to define. Goals directly affect the type of decision being made. The result of a decision may be to produce a plan or regulation, to educate, or simply to identify land that will have a regional impact on conservation. Is the decision part of a long-term course of action or does it have a single objection? The evaluator must also identify the criteria for decision-making. The measurement strategy will be drastically different among the various types of decision makers and the desired outcome. Included in the criteria would be the values assigned to the usefulness of a variety of types of information available in the map viewer of the GeoBook.

Another major facet of the evaluation category is to identify what might not be possible in the absence of the information technology. This can range from types of analysis, visual presentation, or efficiency in assisting decision-making. This step will allow the evaluator to put the information technology in context of the present day.

Relevance of Information Technology to the Issue

This section will compare the goals of the GeoBook to the relevance of the information technology included. There should be a detailed description of the complexity, limitations, and assumptions associated with the science. Factors such as scale and form of the datum affect the quality and accuracy of the information produced. For example, a higher resolution of aerial photography is necessary to make accurate parcel-level decisions while a lower resolution may meet the needs for regional decisions. The specific information needed for different types of decision-making directly affect the amount of detail desired from information technology, thus affecting the satisfaction one may receive. Because land-use changes quite frequently, land-use decisions need current data, and for the same reason it is difficult to obtain current data. Outdated information may not be relevant to the situation. It is also necessary to determine the impartiality of the information. A conclusion can be drawn from this analysis as to the appropriateness of the scientific data to the decision-making process.

It is vital to the evaluation process to understand how planners, decision-makers, and stakeholders interpret the information. This section of the evaluation determines how easily information technology is presented and understood and to what degree the

technology improved understanding of the information. The evaluator must also look at the relevance of the science to planners and decision-makers. This can be accomplished by asking for the perception of relevance of the information.

Capabilities of the GeoBook

This category is important as it evaluates the effects of the GeoBook on the decision-making process. The GeoBook's effectiveness depends altogether on information quality and relevance. The GeoBook will be dissected into its various parts and its capabilities will be revealed. The system's contents can be scrutinized by contacting those who distribute the application, those who use it, and with personal application. This will reveal the type of analysis that can be performed and the type of information that can be generated. The time frame involved in learning to use the system, as well as in retrieving data, is important to the evaluation. This directly indicates the ease of use and learning the system.

Also important is to determine what skills and knowledge are required to utilize the information system. Typically, GIS users with more experience can perform more complex analysis, are less likely to commit critical errors, will better understand the system, and will be able to perform more tasks in a shorter amount of time that less experienced users. The EPA Region IV stated that one purpose of the GeoBook is to reduce the drawbacks of using GIS in the planning process, in particular, the expense of training and equipment. In light of this, the ease of interpreting the data and applying the information to the current issue is vital in the success of the GeoBook. The clarity and

understandability of the information greatly influences its usefulness. If the user cannot understand the information, then it will have very little impact on the decision. The appearance of the information and how it is presented also affects the user's understanding of the information. Discovering to what degree, and possibly what stages, the information technology was utilized in the planning process is key to evaluating the GeoBook's success or failures.

Impact of the Information Technology

This methodology incorporates three elements for determining the impact of the science on a planning or decision-making process. First, identify any impact made by the participants. Did the information presented give new and useful information or change previous notions? Next, the measure of influence the information technology had on the final decision or outcome is an indicator of the system's capabilities. Naturally, the weight given to the final decision or outcome ensuing information in the GeoBook directly coincides with the importance of the information science to the planning or decision-making process. If priorities for land protection were identified based on information in the GeoBook, then it is a success. The final element of this category is to uncover any additional problems or concerns identified as a result of the science and technology.

Methodology Techniques

Four main techniques will be used to evaluate the five areas of focus in this methodology.

1. Content analysis
2. Personal Contacts
3. GeoBook workshop and EPA Region IV Evaluation Questionnaire
4. And GeoBook's Application to French Broad River Blueway

Content analysis

The term content analysis is applied here to mean summarizing the information contained in selected documents. This will include reviewing documents related to the central issue, such as background information, past or ongoing plans, and research. One way to accomplish this is to contact planners and decision-makers and ask for the aforementioned information. This information allows the evaluator to understand what point in the planning process the information technology was used and to observe any changes in preconceived perceptions or the addition of pertinent information directly stemming from the GeoBook. Since the information considered relevant will greatly vary depending on the type of decision being made, the content analysis will also vary for each planning and decision-making process. Becoming acquainted with the five areas of focus in this methodology and the elements that make up each area allow the evaluator to recognize the essential information whenever it is available.

Personal Contacts

Personal contact will focus on those who have used the GeoBook in any part of the planning process. A consultation will take place with those stakeholders applying the GeoBook to resource analysis in order to gauge their satisfaction with the GeoBook. These consultations will give insight to the important issues surrounding the various types of stakeholders as well as the role information technology plays in decision making.

GeoBook Workshop and EPA Region IV Evaluation Questionnaire

A workshop was conducted to instruct various stakeholders on how to navigate through the GeoBook and other basic operational procedures. This opened the door for those users to take the GeoBook back to their specialties and apply it to their scope of work. The EPA Region IV created a review questionnaire and gave it to workshop participants to evaluate the user-friendliness of the GeoBook in its support of environmental decision-making. The evaluation questionnaire was also given to those who participated in EPA Region IV's field evaluation of the GeoBook. I reviewed the questionnaires returned to the EPA Region IV officials, which then allowed me to identify information not currently in the GeoBook but needing to be included. The questionnaire allowed me to observe the correlation between the familiarity of information technology one has to the degree of difficulty GeoBook presented.

GeoBook's Application to French Broad River Blueway

Finally, an overview was conducted of the contributions of GeoBook to the creation of the proposed blueway and greenway system along the French Broad River Corridor. This was included in each aspect from the methodology by reviewing any existing plans, making personal contact with those decision-makers involved in the process, and an analysis of GeoBook's role in the planning and decision-making process. This overview served as a case-study example of information technology as it is applied to decision-making.

Organization of the Thesis

This thesis is organized into six chapters. The initial chapter is intended to introduce the topic and give some general background as to the purpose and content of the thesis. Chapter Two provides the methodology. Chapters Three and Four provide an in depth analysis of GeoBook's parts and examine its limitations. Chapter Five examines the GeoBook's role in the French Broad River Blueway. Chapter Six provides a conclusion to the strengths and limitations of the GeoBook and its relevance to greenway planning. This chapter will offer recommendations as to what can be improved to help EPA Region IV make the GeoBook more useful.

CHAPTER 3

DESIGN OF THE GEOBOOK

A company called Space Imaging created the GeoBook according to the specifications requested by the EPA Region IV. It is designed in such a manner that it mimics a book with GIS information presented on pages, which are then organized logically into chapters. Users may turn the pages of the book to reveal images, maps and supporting content. Individual books can be cataloged into a library so users can maintain a consistent flow to all the data they need to distribute in GeoBook format. GeoBook is not a tool meant to display stagnant data; it allows users to manipulate data, exploring imagery, and have GIS and information content. One can zoom in or out, adjust the viewing area, turn layers off or on, query information such as street names, latitude and longitude coordinates, and develop maps based on the individual's needs.

Mechanics and Functions

The GeoBook is divided into three main sections. Figure 2 shows the opening page of the GeoBook as it looks on one's computer screen. The first is the Introduction, which has instructions on how to use the GeoBook and the Map Viewer button tools.

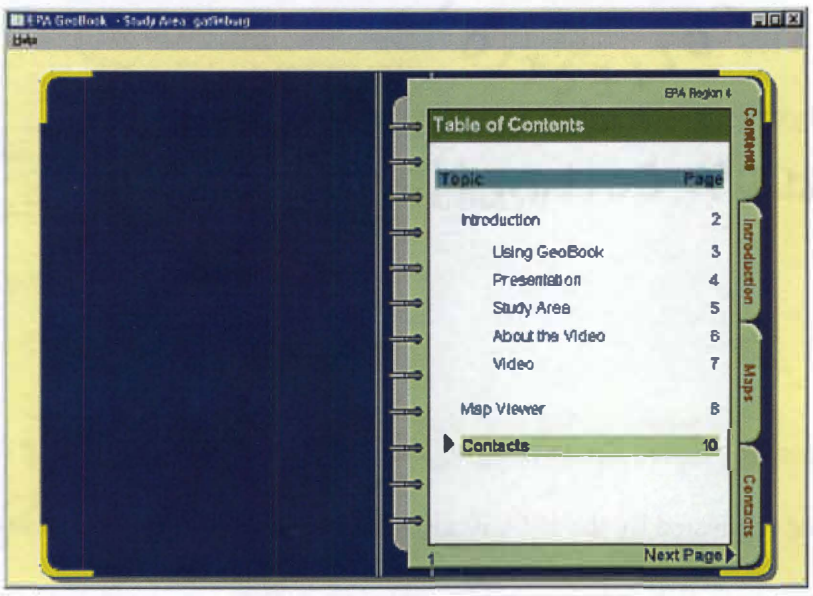

FIGURE 2. OPENING PAGE OF THE GEOBOOK

Also available is a Microsoft PowerPoint presentation that provides some basic information on the methodology used to develop the SEF and identifies some of the current applications that are being implemented. The user does not need to have PowerPoint software to view the presentation. The presentation can be saved so that it may be viewed or presented in another context. The Introduction also has an outline of the study area as well as a two-minute video that shows the significance of the connectivity suggested by the SEF. This is a positive addition to the text because it allows the user to visualize what is being said. It is also important to note that right clicking on any of the GeoBook parts signals the print option.

The next section is the Map Viewer. You can see what the Map Viewer section looks like in Figure 3. In the map viewer section you can choose from eight themes. The

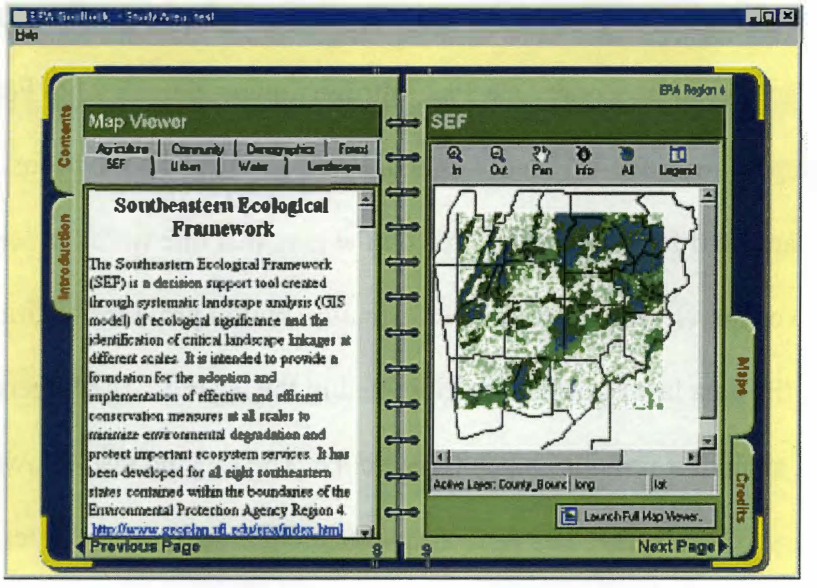

FIGURE 3. EXAMPLE OF MAP VIEWER SECTION

themes are as follows: Agriculture, Community, Demographics, Forest, SEF, Urban, Water, and Landscape. In each theme, a different set of map layers available. Appendix 2 is a spreadsheet that names all of the layers available in the themes. Under each theme in the Map Viewer section is a list of the available themes and a brief description of each. Each description is equipped with hyperlinks that provide additional information on that topic. These hyperlinks are useful because they provide more detailed information without requiring the EPA Region IV to engage the repetitive work of explaining what is already available through the Internet. For example, a user who uses the GeoBook's Demographic map viewer may also want additional information on one of the layer available such as environmental justice, which is made possible by the hyperlinks.

The map in the Map Viewer section launches to a full map viewer, which is much larger and makes it easier to create maps. An example of the Full Map Viewer can be

seen in Figure 4. When in this mode, all that can be seen is the map. The eleven available tools are Zoom In, Zoom Out, Pan, Information or Identify Map Features, All, Launch Full Map Viewer, EPA, Photo, Legend, Print, and Edit Tool buttons. Zoom In and Zoom Out are used for selecting an area on the map that one wants to see more detail. Pan moves the viewing area. The Information button provides additional information on the data layer you have highlighted in the legend. The Legend tool serves just as a legend should, it provides a key to symbols. The Legend also allows the user to choose the layers to be displayed as well as change the hierarchy of the layers. The All Tool restores the map area to include the entire map. The EPA tool directly connects the EPA's EnviroMapper website to the GeoBook. This allows the user to view available data for the same area of concentration. The EnviroMapper maps environmental information such as air release, toxic release, Superfund sites, and water discharge permits. The Photo tool directly connects Microsoft's TerraServer website to the GeoBook. As in the EnviroMapper, the area viewed in TerraServer will be that of the area being viewed in GeoBook, but the resolution will be at a much higher level. This gives the user an additional perspective. The Print Button allows the map to be printed to the default printer. It is very important to set your default printer to the one that you would like your maps to print on because there is no option to change printers when this tool is selected. The Edit tool allows the user to create a polygon around a parcel of land known by the user to be currently managed, protected or some sort of environmental

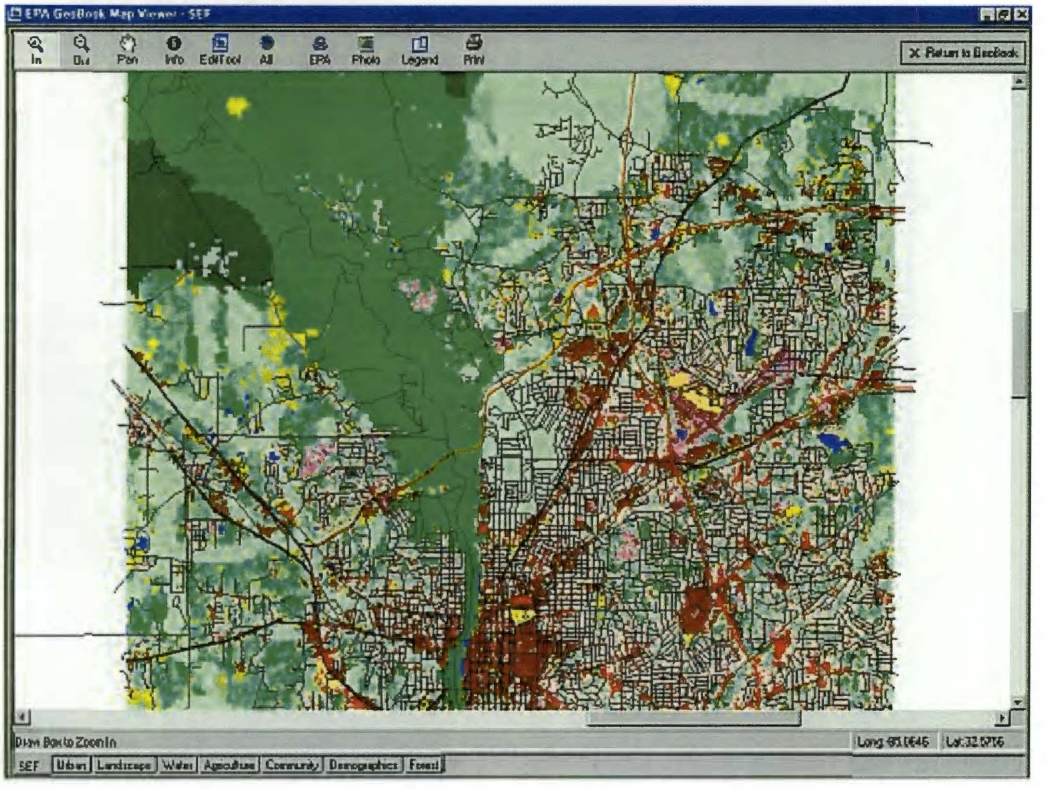

FIGURE 4. EXAMPLE OF FULL MAP VIEWER

easement not displayed. After the user creates the polygon, the program will ask basic contact and property use information to save along with the polygon. It is then available to email the files to be included in any updates of the protected or managed areas. The last two buttons are Launch Full Map Viewer and Return to GeoBook. Launch Full Map takes the user to a large version of the map and Return to GeoBook takes the user out of the large map and returns them to the original GeoBook setting.

The last section in the GeoBook is the Contacts section. Here, the user can retrieve the contact information for EPA Region IV and those who work with the GeoBook, contact information for Space Imaging, the University of Florida Geoplan

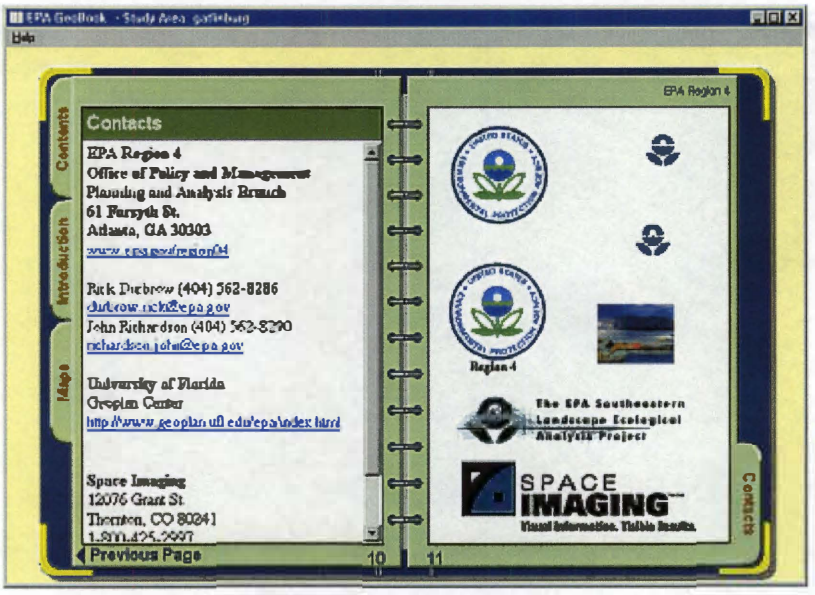

FIGURE 5. EXAMPLE OF GEOBOOK CONTACTS SECTION

Center's website, and credits for the GeoBook. Figure 5 gives an example of the contacts section of the GeoBook.

Data Layers

The following is a list of data layers available in GeoBook. The meanings of these data layers are not intuitive, so provided is a brief description of each directly from the descriptions in the GeoBook. Also included are the data sources.

Watersheds- Displays watershed boundaries with data from the US Geological Survey data for eight-digit hydrological unit codes (HUCs). These watersheds include all land where water, from rain or runoff, drains to a specific water body.

States- Shows state boundaries and serves as a visual reference to identify natural resources that may cross state lines.

Counties- Shows the county boundaries and a visual reference for identifying locations on the map and navigating around other data sets.

Riparian Mask- Shows different land types within a one-hundred foot buffer along the banks of a particular waterway. This data is from the National Land Cover Data (NLCD) and USGS data. The riparian zones identified are those either in their natural state and need preservation or are under possible threat of alteration or removal.

303D- Identifies impaired waterways within the mapped area. Impairment can be a result of excess nutrients, sediments, chemical pollutants, animal wastes or other forms of contamination. The data identifies the streams that each state considers impaired (standards vary from state to state).

Rivers- Provides coverage of rivers and streams and comes from the USGS's National Hydrologic Data (NHD).

Highways- Shows the Major Highways within the specific map area. One can see where ecological areas are (or will be) being fragmented. This data is from the 1995 Topologically Integrated Geographic Encoding and Referencing (TIGER) system database.

Cities- Shows municipal boundaries for cities and towns that can identify locations where land development is moving away from the city's center and may be threatening water and ecological resources or contributing to habitat fragmentation. It can also be used to design urban greenways and trails that tie into the larger ecological hub and corridor system.

USFS EcoRegions- This data comes from the 1995 USDA Forest Service classification of regional land types.

Land Values- Provides the average estimated market value of an acre of land at a county level. The data is from 1992 Department of Agriculture Census and provides insight to the economic tradeoffs involved in land-use changes from agriculture to development. This can be useful to a county or municipal planner's decision making within the context of economic issues.

Property Taxes- Provides the total of farmland Property Taxes paid in $1,000s within the selected county. The data is from 1992 Department of Agriculture Census and also provides information about tradeoffs made from agriculture/development land use changes within a county.

CRP WRP- This is the total amount of Federal dollars spent in a county for the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP) and is useful when comparing counties. This information comes from the 1992 Department of Agriculture Census.

Fertilized Acres- Provides the total acres of land fertilized in each county. This data is from the 1992 Department of Agriculture Census.

Irrigated Acres- Provides the total acres of irrigated land per county. This data is from the 1992 Department of Agriculture Census.

Ag Sold- Provides the total of All Agriculture Products sold in $1,000s per county. This data is from the 1992 Department of Agriculture Census.

Crops Sold- Provides the total of all crop products sold in $1,000s per county. This information can be used to determine the importance of crop sales to a county's economy. This data is from the 1992 Department of Agriculture Census.

Livestock Sold- Provides the total livestock and poultry products sold in $1,000s per county. This is significant of the importance of livestock sales to a country's economy. This data is from the 1992 Department of Agriculture Census

Land Cover- Shows different types of land cover within the mapped area and an overview of where each land cover type is located within a watershed or county. This data also shows where land uses are encroaching on other land types. This information came from the National Land Cover Data developed by the USGS and the US EPA.

SEF Detail- Identifies the hubs and connectivity of the SEF along with other areas outside the SEF designated as Priority Ecological Areas (PEA) and Significant Ecological Areas (SEA).

Surface Intake- Depicts segments of rivers that are located near surface water intakes. This coverage is important for protecting drinking water for local populations.

Mines- Shows the location of current and past mines and the primary products extracted. Mines can be a source of water pollution.

Railroads- Shows the location of major railroad lines and is useful because abandoned railways have been used to develop greenway trails to connect urban areas to parts of the SEF.

Dams- Shows the location of dams along streams and rivers. This can be useful in finding places where the natural flow of a stream or river may be impeded or altered. Farm ponds created by stream dams is also shown.

TRI_REL- Is the total sum of emissions from facilities reporting under the Toxic Release Inventory. This data is the sum of emissions to air, water, or land as well as emissions off-site or fugitive emissions.

SF Status (Npl_Stat_I)- Identifies the current status of superfund sites in the Southeast.

RCRA- Identifies locations that fall under the Resource Conservation and Recovery Act. The objectives of the RCRA are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

NPDES- The National Pollutant Discharge Elimination System (NPEDS) shows the location of permitted facilities that discharge pollutants into waters of the U.S. The conveyances from the facility are called point sources.

Recreation- Represent sites of recreation such as golf.

Schools- Location of schools from the Environmental Systems Research Institute.

Institute- Provides information on the community resources in your watershed. The data is from Environmental Systems Research Institute and identifies hospitals, schools, and cemeteries. These locations are important when making development decisions.

Airports- Shows the location of municipal and other major airports in the mapped area.

Parks- Represents State and Federal park areas and may overlap with the managed areas database. Parks help make up the hubs in the SEF.

Landmark- Provides information on the location of historic sites or points of interest. This data can assist in the evaluation of potential tourist issues that may be supporting the community's economy.

Lakes- Displays the major lakes and reservoirs in the mapped area.

EJ- The Environmental Justice (EJ) data set shows the location of low-income and minority populations in each county. This information is useful to make sure planning

decisions do not adversely impact these populations and to identify diverse members for stakeholder groups. The EJ program ensures that all people are treated fairly with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Population Change- Identifies the change in population between 1990 and 1997. The spatial resolution is based on the census tract level.

Federal Lands (AGBUR)- Shows the location of lands owned by the US Forest Service, Fish and Wildlife Service, National Parks Service, Department of Defense, Tennessee Valley Authority, and Bureau of Indian Affairs.

Forest- Shows the following four forested land cover types: evergreen, upland deciduous; mixed; and forested wetlands. Identification of forest types and locations is a helpful tool for understanding the various habitats in your community. Additionally, each forest type has its own unique role in both providing an protecting natural resources.

Forest Density- Shows the percent of forested land cover within a one kilometer cell. The U.S. Forest Service developed this data from satellite in the early 1990s.

PCT Riparian Forest in HUC- The Forested Riparian data set shows both the percentage of and total acres of froested land within each one-hundred meter wide riparian buffer for a given watershed. This data is from the USGS National Land Cover Data (NLCD).

PCT Forest in HUC- The Forested Watershed data shows both the percentage of and total acres of froested land in each watershed. This data is from the USGS National Land Cover Data (NLCD).

Roads- This layer provides reference for locating specific target areas and identing the principal fragmentation stressor to the landscape and comes from 1995 TIGER database

SEF Mask- Allows the user to see what other layers exist within the SEF for a given location.

Managed Areas- Represents many types of federal, state, and local managed lands. These, too, help make up the SEF hubs.

Conservation Lands- Include various types of management from national parks and forests to local parks and conservation areas.

SEF- Identifies all lands that have been included in the SEF and does not distinguish between hubs and corridors that connect them.

SEF Biodiversity- Assessment relevant to identifying areas that are potentially most important for conserving biodiversity because these areas are most likely to support viable opportunities to conserve biodiversity. This coverage is the regional biodiversity selected for the SEF.

Regional Biodiversity- Assessment relevant to identifying areas that are potentially most important for conserving biodiversity. Additional data on location of species of conservation interest and natural communities and the identification of areas most important for conserving viable populations of those species are important and to be enhanced in future iterations.

SEF Ecosystem Services- Ecosystem (or ecological) services are ecological processes and functions provided by natural and semi-natural areas that help sustain or enhance human life. Primary ecosystem services are water and air protection and purification, flood and storm protection, functional nutrient cycling, etc. This data has been selected for the SEF.

Regional Threats- Assess the threats from intensive land uses and roads that can both negatively affect ecological integrity existing natural and semi-natural lands, and the likelihood that such lands will be converted to residential or urban land uses.

Road Density- Shows the density of roads in miles per square mile of land from the 1995 TIGER database. This information is useful in providing insight to areas that are more accessible to urban sprawl and development pressures.

Potential for Urban Growth- Show the existing urban areas along with areas with the greatest projected potential for becoming urbanized or converted to residential or commercial development. To create this data, mapping analysis was done using 1993 land cover data set looking at an area's distance to roads, distance to urban locations, and

the urban density within a one mile and five mile radius from existing urbanized land. This data will be updated using changes in population density between the 1990 and 2000 census.

Urban Land Cover- Three classes of urbanized land are in the National Land Cover Data (NLCD). Low-Density Urban is low-density residential, Medium-Density Urban is high-density residential and light commercial, and High/Industrial class is urban centers and industrialized areas. This layer was created by the USGS satellite photographs from the early 1990's.

Water Bodies- Represents lakes, ponds, and impoundments from USGS National Hydrography Database (NHD).

Flood Zone- These flood zones were delineated by the Federal Emergency Management Agency (FEMA).

Soil Permeability- The soil permeability information is based on STATSGO, the state level soil database. This is important when dealing with potential flooding and non-point source runoff issues that impact the quality and quantity of water resources in the community.

Riparian N-Index- This is the percentage of natural vegetation along riparian areas in a watershed in a natural states. Typically, a low N index percentage indicates possible water quality and quantity issues.

HUC N-Index- Shows the Natural System's Index for Watersheds percentage of land in a watershed that remains in a natural state.

Elevation- Is represented in feet and is important to determine water flows. This data is from the USGS National Elevation Data.

CHAPTER 4

CAPABILITIES OF THE GEOBOOK

This chapter will be looking at the capabilities in the context of greenway planning. It also describes three methods in which the GeoBook was presented to new users and the limitations of the GeoBook, as well as comments made by others who participated in field evaluations of the GeoBook. First, a group workshop was conducted second was by personal exploration. This chapter records the limitations of the GeoBook from three information sources, the workshop, personal experience, and EPA Region IV evaluations. The observations recorded were made by the workshop participants and others involved in the field study come from the surveys they filled out given to them by EPA Region IV. A blank copy of the survey is located in Appendix 1 of this thesis.

Issue of Concern

This analysis constitutes the kind of information needed to make decisions that will be initiated by city and county agencies and non-government organizations. GeoBook is being evaluated most specifically to determine how to use information in the GeoBook to facilitate planning as expressed later in this chapter, in a format that is best suited to this type of analysis.

Characteristics of the Planning and Decision-Making Process

In the context of land-use decision process, the SEF and GeoBook are designed to specifically facilitate these issues of GeoBook. More specifically, this analysis will be looking at the French Broad River Corridor. The players are city and county land-use planners, the metropolitan Planning Commission, and the Seven Island Refuge non-government organization. The decision-making process at this point is very much in a conceptual state.

Relevance of Information Technology to the Issue

The GeoBook, which is the information technology, relationship to this issue is extremely relevant. The kind of information that can be accessed contains key elements that go hand in hand with the process. More specific information will follow.

Getting to Know GeoBook

The workshop provides an orientation to the GeoBook was held at the University of Tennessee, Knoxville, on Wednesday, March 19, 2003. The objectives of this meeting were to overview the EPA Region IV's Southeastern Ecological Framework, to overview the capabilities of the GeoBook, to create an application of the GeoBook for the French Broad River and Nine Counties One Vision, and to evaluate the relevance of the two applications devised.

Before the meeting began, the attendants were encouraged to prepare in several ways. The first step was to visit the section of the EPA Region IV's web site describing the Southeastern Ecological Framework and to become familiar with the Ecological Framework and GeoBook programs. Next, those involved in the French Broad River Corridor were to define the spatial analysis themes desired for the projects. Identify geo-spatial databases they would like to utilize. Define the boundaries of the French Broad River Corridor. Discuss how this information will be used in their planning and policy development. It was also recommended to have someone with GIS expertise represent the projects.

Workshop attendees represented perspectives from several backgrounds that include federal agencies, state agencies, local agencies and non-profit organizations, such as the National Park Service, Knox County Greenways Planner, the City of Knoxville, and watershed associations. The attendees were asked to identify their interests and what they would like GeoBook to help them accomplish. One attendee's interests were to use the GeoBook with a watershed association for planning and education; for working with agencies to focus on green spaces and corridors; to locate funding; and to identify priorities for protection. Another attendee named finding the best opportunities to link green space from Asheville, North Carolina, to the Tennessee state line along the French Broad River, as well as finding the barriers to green space linkage. Another participant wanted to locate sensitive lands that might be conserved alongside the French Broad River along with land most at risk and where those pressures are. The GeoBook has been applied in several fashions.

The participants were also asked to identify map layers that may be of interest to them. The responses were as follow: existing conservation areas, archaeological sites, superfund/ degraded areas, greenway locations in public land, actual ownership of land, and wetlands. As a whole, those involved in the workshop were very optimistic about the GeoBook's potential to assist them in land-use decisions. The limitations of the GeoBook found by workshop attendees were recorded in the questioner and will be discussed in the next section of this chapter.

I took the opportunity to learn GeoBook on my own. My goal was to put myself in the situation one would be in if one were introduced to this program without any previous training or knowledge. My background does include a working knowledge of some information technologies such as ArcView GIS. As of this date, to receive the GeoBook one must contact someone at the EPA Region IV headquarter and ask them for the program. Since the files are very large they must first be compressed, which translates into the fact that large areas cannot be viewed on one compact disk. The program was given to me on a compact disk with clear directions accompanied by pictures of how the installation process is done. Some programs, such as Windows Media Player, are needed for the application to run effectively; when such is the case, an automatic message will display asking those with a less that adequate program to update their computers. This is essential because it eliminates the need for all users to know what programs, and versions, their computer may have and which of those GeoBook needs. To begin my analysis, I spent time reading the information given in the GeoBook

program and then created maps to be used in the creation of the French Broad Blueway. This is how I found the weakness inherent in the system.

Limitations of the GeoBook

The limitations discussed in this section come from personal experience, from comments on the EPA Region IV Evaluations, and from comments made by workshop participants. A major limitation in the GeoBook's design is its lack of primary map construction options. Important, and very basic, information such as scale, border, legend, key, title, source, north arrow, and the date produced should be included on every map, however, they are not available on the GeoBook maps. The Map Viewer legend does not provide information for all of the symbols included in the map and it cannot be printed. For example, the legend does not decipher the field values for the watershed layer. The viewer must flip back to the explanations to see the definition of a symbol. It would also be very helpful if one could determine the scale of the map being worked with. To produce maps that could actually be used away from the GeoBook program, I had to print the map I created, then print the Map Viewer explanations and cut out the legends, to complete the map I then pasted all this information to a larger size paper. This method does not work with each map, since the key for some layers is not available in the explanation section, and therefore cannot be printed. Such is the case with the Soil Permeability data layer in the Landscape theme. It is problematic that one cannot save the map created. It would be a very nice option to save the map product so it can be shared with others by the use of an electronic file and it would allow one to return to that

product in the future. The print option automatically prints to the default printer without offering any print options. Consequently, it is not available to change the printer destination, the layout, or other such information normally permitted. It is available to print the notes page, but the instructions on how to accomplish this are not clear. It would be much more helpful if the instructions were located in a more obvious place than the notes page. I ran into trouble printing multiple maps in one sitting. The maps printed were not the maps I created. To remedy this, I had to close the program each time I wanted to print a new map.

Another shortcoming of the GeoBook is one cannot create maps using data layers unique to individual themes. The GeoBook utilizes unique sets of data layers with each individual theme. Because of this design, it is extremely difficult for users to know which theme is appropriate for their query. For this reason, I created the Data Layer matrix located in Appendix 2. The most cited complaint from GeoBook users is it lacked flexibility in combining layers between the themes. Some of the themes lacked vital layers that should an option on all themes. For example, the SEF theme does not have rivers and streams layers, yet the SEF is a critical determinate of greenway planning. The GeoBook data layers contain a great deal of useful and valuable information. However, multiple users expressed the opinion that some potentially helpful themes were missing. An open space planner requested public utility easements, such as power lines, gas lines, or water lines, be a layer or database. This would be very supportive in the identification of potential greenway sites. Additional information themes for which a desire was expressed and are currently not in the GeoBook are archeology, geology, threatened

endangered, endemic, and or rare species, privately owned property, and bio-geographic regions.

Basic editorial problems exist in the GeoBook such as misspelled words and inaccurate information. For example, the Water theme key says 303B when it should be 303D; the parks section in the Community theme says "my" when it should be "may"; the Agriculture theme repeats the explanation for Riparian Mask. TRI has no explanation of the scale categories- low medium, and high. Additionally, some of the web-addresses present difficulty or do not link to the site. I manually searched the Uniform Resource Locator's (URL) instead of relying on the hyperlinks for those address that presented difficulty, and a few of the sites then became available. The others were just never located. Sometimes the computer displays a "run time error" message and automatically shuts the computer off; I have found no explanation as to why this occurs. Some of the information given in the GeoBook is not complete. For instance, the Info button does not provide information for all databases for a given theme. Also, some units of measurement are questionable. The Flood Zone data layer does not specify which flood zone is being displayed; it could be a one hundred or fifty year flood zone.

Some of the workshop participants who were skilled users of GIS said that while the GeoBook was too basic for most of their needs, it is useful as a tool in building public awareness, as supplementary visual aid, and as a quick overview of the area being researched. If these types of users cannot manipulate layers, then the tool basically is a

reference item rather that the foundation for individualized maps and analysis. It would be beneficial to have the GIS layers available for incorporation into GIS programs.

The bulk of the problems found by those who were not expert in GIS were very basic in nature. Actions such as scroll or zoom presented problems. The answer to most questions presented in their responses can be found in the GeoBook help or information section. The problem with this is it is very time consuming to read all of the information in GeoBook. Without memorizing this information, the user must continually flip through the pages of the GeoBook to answer questions, which tends to be discouraging for those involved. So, the GeoBook is likely to not be used as often as it potentially could.

CHAPTER 5

GEOBOOK AND THE FRENCH BROAD RIVER

The French Broad River has been identified as a valuable asset to Knox County and to the surrounding region. This river is the world's third oldest and has been the center of conservation efforts for many years. The French Broad River Blueway is ultimately intended to extend throughout its entire length. Nine Counties. One Vision. is a regional planning organization made up of East Tennesseans who came together so that they may create a collective vision for the region. The French Broad River Corridor Study was developed in reaction to the desire of Nine Counties. One Vision. to protect the region's rural heritage and it focuses on the Lower French Broad River, about the fourteen miles that runs through Knox County. The purpose of this study is to "(1) identify significant natural and man-made assets along the Lower French Broad River, (2) outline options to conserve a rural heritage; and (3) establish a framework whereby other rural communities in the Nine Counties area can assess their resources systematically and begin a process to conserve their heritage" (Knoxville Knox County Metropolitan Planning Commission, 2003). This study identifies the French Broad as essential to the health of the region. In addition to the findings of the French Broad River Corridor Study, the entire French Broad River is identified as an important ecological corridor in the SEF. Three of Knox County's major open space areas are located on this

river, totaling well over one thousand acres; Ijams Nature Center, alongside the Eastern State Wildlife Management Area are at the southwestern end of this corridor, with Seven Islands Wildlife Refuge at the opposite end. These three areas of open spaces frame the proposed corridor. The French Broad Blueway is a concept that encourages protection of the river and low-impact recreation, such as fishing or canoeing, and extends to Asheville, North Carolina. The work to develop this blueway has encouraged the planning of additional greenways along the French Broad River throughout its entire length. Linking extensions of open space between publicly accessible historic sites and reclaiming railroad right-of-ways between the abandoned marble quarries to make pedestrian, equestrian or rail trails is one of the ideas.

GeoBook and the French Broad River Conservation Corridor

Karen Nolt, Knox County's Greenway and Park Coordinator, was involved in the French Broad River Corridor Study and is heavily involved in many projects which involve the creation of the French Broad Blueway. She has authored a report entitled, The French Broad River Conservation Corridor; A Model, Multiuse Open Space Corridor to Conserve, Protect, and Enhance the Natural Beauty, Rural Heritage, Wildlife Habitat, and Outdoor Recreation on and Around the French Broad River (Nolt, 2003) sponsored by Knox County Parks and Recreation, Seven Islands Foundation, and the Metropolitan Planning Commission. In this report, Mrs. Nolt proposes that Knox County create a system of public parks and greenways called the "Sapphire Necklace" to mimic that of Frederick Law Olmsted's Emerald Necklace in Boston. She identifies seven "jewels,"

which are resources that are unique to this area and can be utilized in the connective tissue of the Sapphire Necklace concept.

Included in this report are maps from the GeoBook, which are intended to reinforce the regional significance of the French Broad River Corridor. These maps are available for viewing in Appendix Three of this thesis. The maps also highlight the corridor's importance as an area of resource protection, natural resource management, outdoor recreation, historic and archaeological value, and its beauty and character. The GeoBook layers used in the report are SEF Detail, Land Cover, SEF Ecosystem Services, Counties, and Roads. As mentioned in the Limitations of the GeoBook section of this thesis, the maps in this report are not equipped with the appropriate information. To supply the reader with a key, the appropriate description page in the GeoBook's Map Viewer was printed and then placed in front of the maps. These maps would read much easier if the person viewing them didn't have to flip from the maps to the description pages just to ascertain what the colors represent. Because the GeoBook doesn't allow the user to create a label on the printed map, labels were made in another program, printed, cut out, glued to the top of the maps, then photocopies the map. Also, because GeoBook doesn't allow the user to save maps created, Nolt cannot go to a saved file to retrieve the maps she has already created. She keeps copies of the maps and descriptions and then when she needs to include them in a document, she then photocopies them and attaches them to the end of the report proceeded by a brief description of what the maps are. Not being able to save the maps doesn't allow the GeoBook to be a part of an electronic document.

Some additional data not included in the SEF theme available in the GeoBook maps would have been useful in the planning process. The Rivers data layer is in not available in the SEF theme. This is a great disadvantage because the GeoBook is being used to aid in the creation of a blueway. Also helpful to the planning process would be the inclusion of mines, dams, and railroad data layers in the SEF theme. In particular because The French Broad River Corridor Study mentions that it would like to use the old quarries and railroad right-of-ways to create a network of greenways connecting to the French Broad River Blueway. Because the proposed hubs in this network of greenways is proposed to connect at the local historical homes and areas, the addition of a data set that includes some historical or archeological information it would be helpful to this concept. In the GeoBook's present state, it only offers general concepts. The GeoBook, understandably, does not incorporate information at the parcel level; however, it would be very helpful to provide some guidance to the users to suggest how to do so.

CHAPTER 6

CONCLUSION

The motivation behind EPA Region IV's desire to create the GeoBook stem from a growing need to integrate available science and technology to the decision-making process. To accomplish this, the technology must be formatted so that it doesn't require a specific set of skills in addition to being widely accessible. If these prerequisites are met, then the potential of the information technology to effect the decisions being made in infinite.

Conclusion and Recommendations

The answer to the primary research question asked in this thesis, the "how useful are the databases and the way they are assembled and accessed in GeoBook to the process of planning for the creation of greenways?" may be summed up by saying the GeoBook has very useful databases. Their assemblage and accessibility are not yet to the point to where its full potential could be. The GeoBook is very effective in displaying the concepts of the SEF. To reach the goal of being a user-friendly program, I recommended the limitations listed in Chapter Four should be addressed. Many of the limitations are minor in nature and can be attuned with very little programmatic change. In spite of the shortcomings, it is important to see the GeoBook's role in future planning

process. The GeoBook's user-friendliness accompanied with its World Wide Web availability would give this information technology the potential to reach those who are making conservation decisions throughout the entire United States. Planners and decision-makers use GeoBook to identify corridors of ecologically significant lands in their areas.

I also recommend the GeoBook highlight cultural resources in addition to environmental resource because these issues go hand in hand. Maybe one of GeoBook's greatest values is providing capabilities for individuals to add a great deal of information to their own specific interests. EPA should articulate more specifically the application of the GeoBook as a public education tool.

A great conundrum exists in the fact that the regionally significant conservation decisions are not being made by those organizations with all the relevant science; decision-makers at a local level are making them. For this reason, those who wish to encourage better decision-making need consider the GeoBook's design. By making scientific information easier to be shared and easier to be understood, it is more likely that that information will reach those involved in incremental planning and decision-making so as to better take into considerations their long term implications on the e environment. This is means scientific data and interpretations can have a conjunctive impact on the world. It is my sincere desire that the GeoBook will be the catalyst in eliminating the separation of those with the information and those making the decisions.

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APPENDIX

Appendix 1

GeoBook Evaluation

This section contains a copy of the Southeastern Ecological Framework GeoBook Evaluation that was opened to all those who participated in EPA's workshops. It is the blank version of the survey that was completed by the participants.

Southeastern Ecological Framework GeoBook Evaluation

Thank you for evaluating the SEF GeoBook prototype. Your comments will be very useful in the finalization of the information that is provided to future users. We will also provide your organization with a final version of the GeoBook for your location.

Please answer the following questions and note any concerns or issues that you encountered during the use of the SEF GeoBook. Thank you again for your time and energy in helping to make this a user-friendly application to support environmental decision-making.

Technical Issues: Please answer in narrative format when appropriate.

Were the written instructions for loading the SEF GeoBook easy to understand?

How easy was it to load the SEF GeoBook on to your computer?

Please provide us with the following information about your computing environment.

Type of operating system ---
Processor speed ---
Hard Disk space ---

Did you run the data from the compact disk provided or hard drive on your computer?

Do you operate in a networked environment or a stand-alone computer?

Informational Issues: Please answer yes or no and provide a detailed comment for each answer.

Did you read all of the written documentation on using the SEF GeoBook?

Was the information provided in the GeoBook useful to your project?

In general, was the information easily understood?

Was the Introduction useful?

Was the PowerPoint presentation useful?

Was the Video useful?

Was the Help File useful?

Was the introductory description of the Map Viewer and tools sufficient?

What was your primary task in using the SEF GeoBook information?

Did the web links provide you with additional information that helped you in your task?

What additional data layers would have been helpful and why?

What additional map themes or combination of themes would be helpful to doing your work?

Map Viewer Issues: Please answer fully

Please indicate the value of each button on a scale from 1-10 with 1 being the lowest value and 10 being the highest value. Any additional information you would like to discuss in relation to the tools would also be helpful.

Zoom In	1	2	3	4	5	6	7	8	9	10
Zoom Out	1	2	3	4	5	6	7	8	9	10
Pan	1	2	3	4	5	6	7	8	9	10
All	1	2	3	4	5	6	7	8	9	10
Info	1	2	3	4	5	6	7	8	9	10
Full Viewer	1	2	3	4	5	6	7	8	9	10
EPA Link	1	2	3	4	5	6	7	8	9	10
Digitizing	1	2	3	4	5	6	7	8	9	10
Photo Tool	1	2	3	4	5	6	7	8	9	10

Were the additional information web links helpful?

Were the funding source web links helpful?

Any other comments that you would like to add?

Appendix 2

Matrix of Data Layers Available in GeoBook

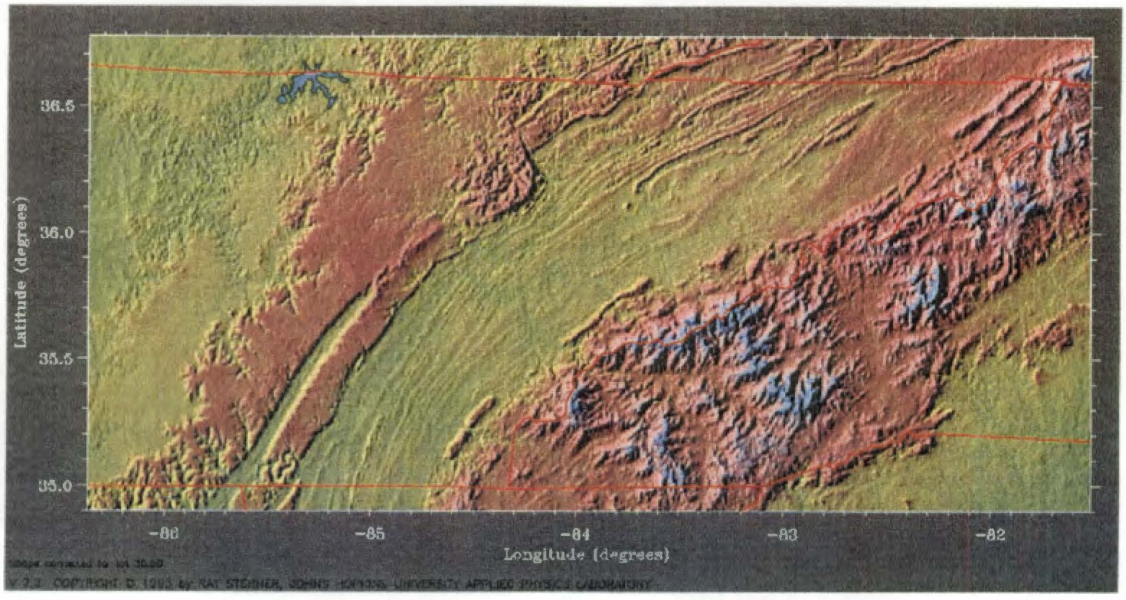
This section contains a copy of an excel spreadsheet I created to display the layers in the GeoBook. This spreadsheet allows the reader to cross-reference the data layers to the themes. It also makes it easier to choose which theme is the one to meet the needs of the user by displaying the data layers in each theme.

	Agriculture'	Community'	Demographics'	Forest'	SEF'	Urban'	Water'	Landscape'
Watersheds'	X	X	X	X	X	X	X	X
States'	X	X	X	X		X		X
Counties'	X	X	X	X	X	X		X
Riparian Mask'	X			X			X	
303D'	X						X	
Rivers'	X	X					X	X
Highways'	X	X	X	X				X
Cities'	X	X	X			X		X
USFS EcoRegions'	X							X
Land Values'	X							
Property Taxes'	X							
CRP WRP'	X							
Fertilized Acres'	X							
Irrigated Acres'	X							
Ag Sold'	X							
Crops Sold'	X							
Livestock Sold'	X							
Land Cover'	X				X		X	X
SEF Detail'	X			X	X	X		X
Surface Intake'		X					X	
Mines'		X						
Railroads'		X				X		
Dams'		X					X	
TRI_REL'		X						
SF Status'		X						
RCRA'		X						
NPDES'		X						
Recreation'		X						
Schools'		X						
Institute'		X						
Airports'		X				X		
Parks'		X			X			
Landmark'		X						
Lakes'		X						
EJ'			X					
Population Change'			X					
Federal Lands (AGBUR)'				X				
Forest'				X				
Forest Density'				X				
PCT Riparian Forest In HUC'				X				
PCT Forest In HUC'				X				
Roads'					X	X		
SEF Mask'					X	X		
Managed Areas'					X			
Conservation Lands'					X			
SEF'					X			
SEF Biodiversity'					X			
Regional Biodiversity'					X			
SEF Ecosystem Services'					X			
Regional Threats'					X			
Road Density'						X		
Potential for Urban Growth'						X		
Urban Land Cover'						X		
Water Bodies'							X	X
Flood Zone'							X	
Soil Permeability'								X
Riparian N-Index								X
HUC N-Index								X
Elevation'								X

Appendix 3

GeoBook Maps From The French Broad River Conservation Corridor Plan

This section contains scanned copies of the maps included in The French Broad River Conservation Corridor; A Model, Multiuse Open Space Corridor to Conserve, Protect, and Enhance the Natural Beauty, Rural Heritage, Wildlife Habitat, and Outdoor Recreation on and Around the French Broad River plan. The maps are preceded by a brief introduction into SEF and the GeoBook and a key. It should become apparent to the reader that these maps would read more clearly if the design was more user-friendly.



The following six maps are part of EPA's Southeastern Ecological Framework. The information presented consists of three scales– the nine county region (1. SEF Detail, 2. Land Cover), Knox County (3. SEF Detail and 4. SEF Ecosystem Services), and the French Broad River Corridor (5. SEF Detail and 6. Land Cover) These tools identify significant ecological areas through systematic landscape analysis. It is intended to provide a foundation for the adoption and implementation of effective and efficient conservation measures at all scales to minimize environmental degradation and protect important ecosystem services.

The three areas included are Land Cover, Ecosystem Services and the SEF detail of Significant Ecological Areas. (See Legend for more information) These three "layers" reinforce the regional significance of the French Broad River Corridor as an important environmental area for resource protection, natural resource management, outdoor recreation, historic and archaeological sites, and the beauty and character of this corridor.

Legend

Southeastern Ecological Framework

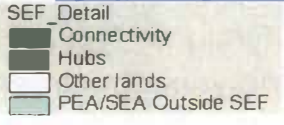
The Southeastern Ecological Framework (SEF) is a decision support tool created through systematic landscape analysis (GIS model) of ecological significance and the identification of critical landscape linkages at different scales. It is intended to provide a foundation for the adoption and implementation of effective and efficient conservation measures at all scales to minimize environmental degradation and protect important ecosystem services. It has been developed for all eight southeastern states contained within the boundaries of the Environmental Protection Agency Region 4.
http://www.geoplan.ufl.edu/epa/index.html

SEF_Detail

Identifies the hubs and connectivity of the SEF along with other areas outside the SEF designated as Priority Ecological Areas (PEA) and Significant Ecological Areas (SEA). Areas outside of the SEF that provide ecological services are displayed because of the value in connecting localized priorities within the context of the larger ecological picture. While the Hubs and Connectivity components are the backbone of the SEF, the PEA/SEA data provides the opportunity to integrate these areas into a community's overall design of greenspace protection. Visit Site1 for more information on the development of the Priority Ecological Areas, Significant Ecological Areas, and overall modeling process of the SEF.

Site1: http://www.geoplan.ufl.edu/epa/

Fund: http://aspe.os.dhhs.gov/cfda/P66419.htm

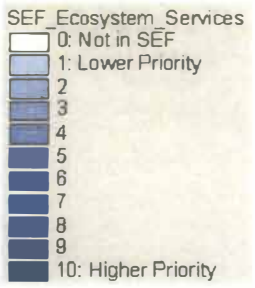


SEF_Ecosystem_Services

Ecosystem or ecological services are ecological processes and functions provided by natural and semi-natural areas that help sustain or enhance human life. Primary ecosystem services include water and air protection and purification, flood and storm protection, functional nutrient cycling, etc. The ecosystem services prioritization is based on available data and techniques. This data has been selected for the SEF. Visit Site1 for more information on the development of this data layer.

Site1: http://www.geoplan.ufl.edu/epa/

Fund: http://aspe.os.dhhs.gov/cfda/P66419.htm



Land_Cover

The land cover data set shows the different types of land cover within the mapped area. Land cover types vary widely and include everything from residential areas to grasslands to forests to pasture lands. This data provides you with an overview of where each land cover type is located within a watershed or county. The data also allows you to see where land uses, such as residential, are encroaching on other land types (i.e. agricultural lands). The information is obtained from the National Land Cover Data developed by the U.S. Geological Survey (USGS) and the US Environmental Protection Agency (EPA). For more information on the NLCD visit Site1.

Site1: http://mac.usgs.gov/mac/isb/pubs/factsheets/fs10800.html

Fund: http://aspe.os.dhhs.gov/cfda/P66463.htm

Counties

The county data set shows the county boundaries. This provides a visual reference for identifying locations on the map and navigating around the other data sets. To adequately protect your community's resources within the SEF may require a collaborative effort with neighboring counties may be required. For additional information on counties you can link to the census bureau at Site.

Site1: http://tiger.census.gov/cgi-bin/mapbrowse-tbl

Fund: http://aspe.os.dhhs.gov/cfda/P10772.htm

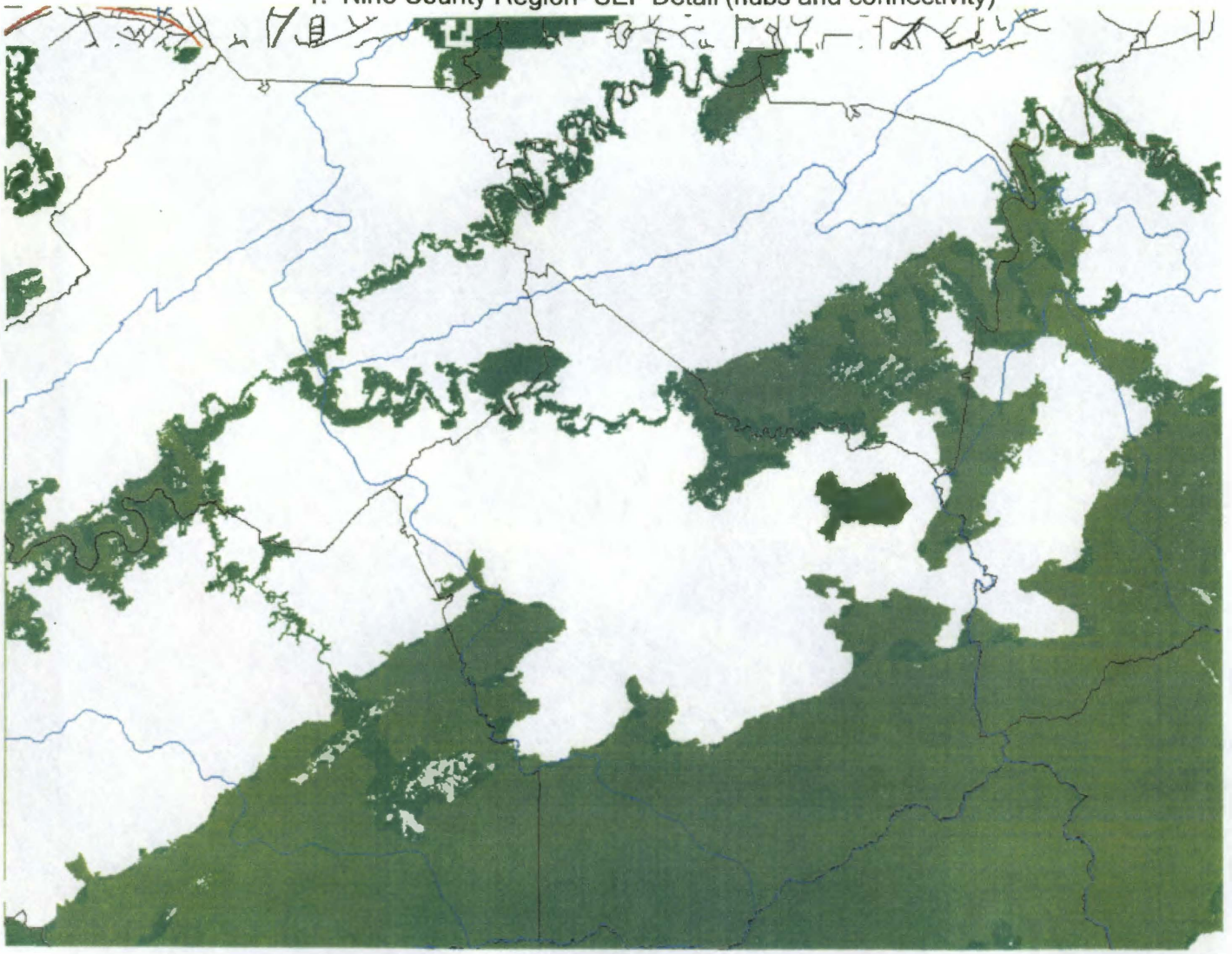
Roads

All roads according to the 1995 Tiger database. This information provides reference for locating specific target areas and also identifies the principal fragmentation stressor to the landscape. For additional information on roads you can visit Site1.

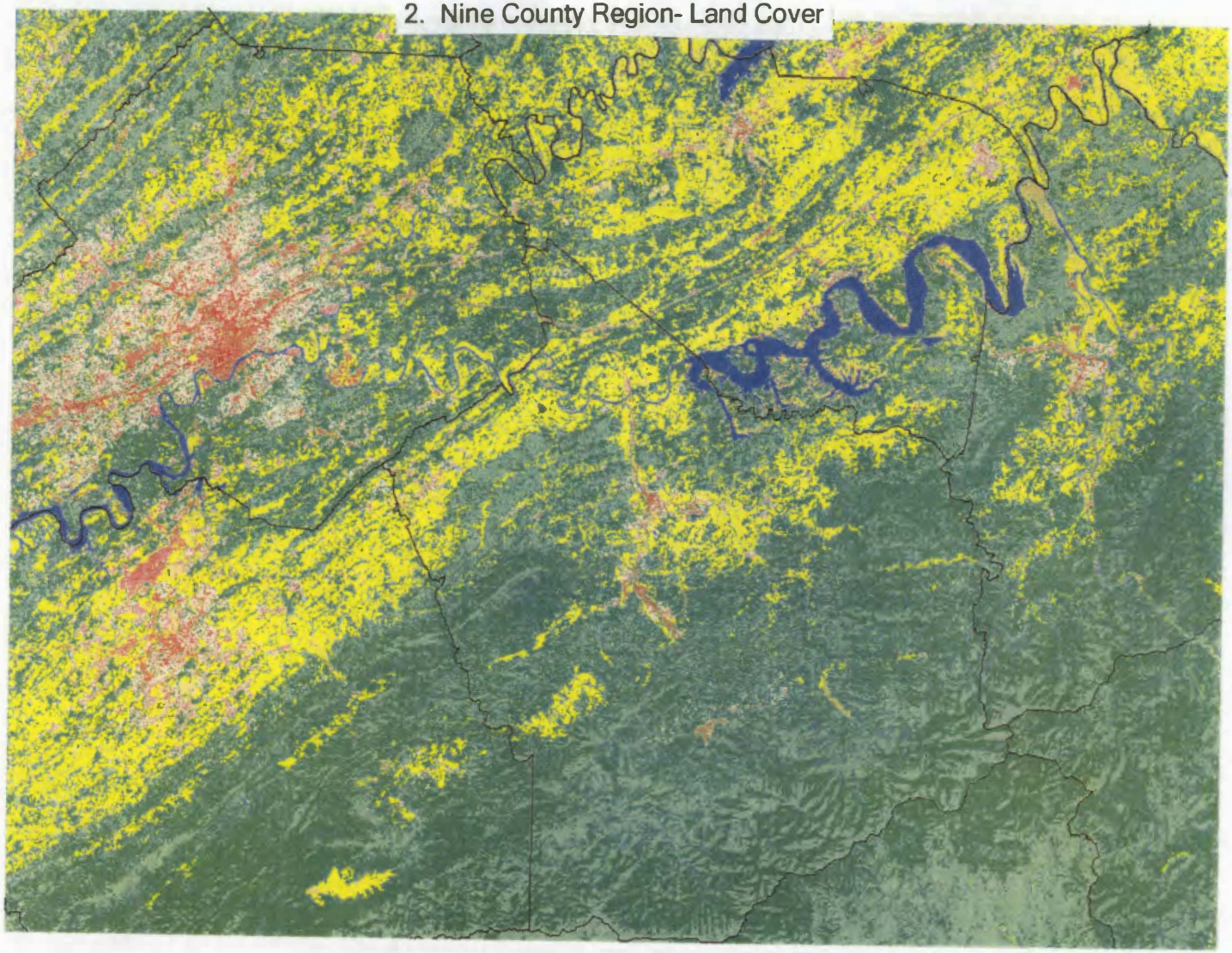
Site1: http://www.bts.gov/gis/download_sites/gdt/state_county.html

Fund: http://aspe.os.dhhs.gov/cfda/P66460.htm

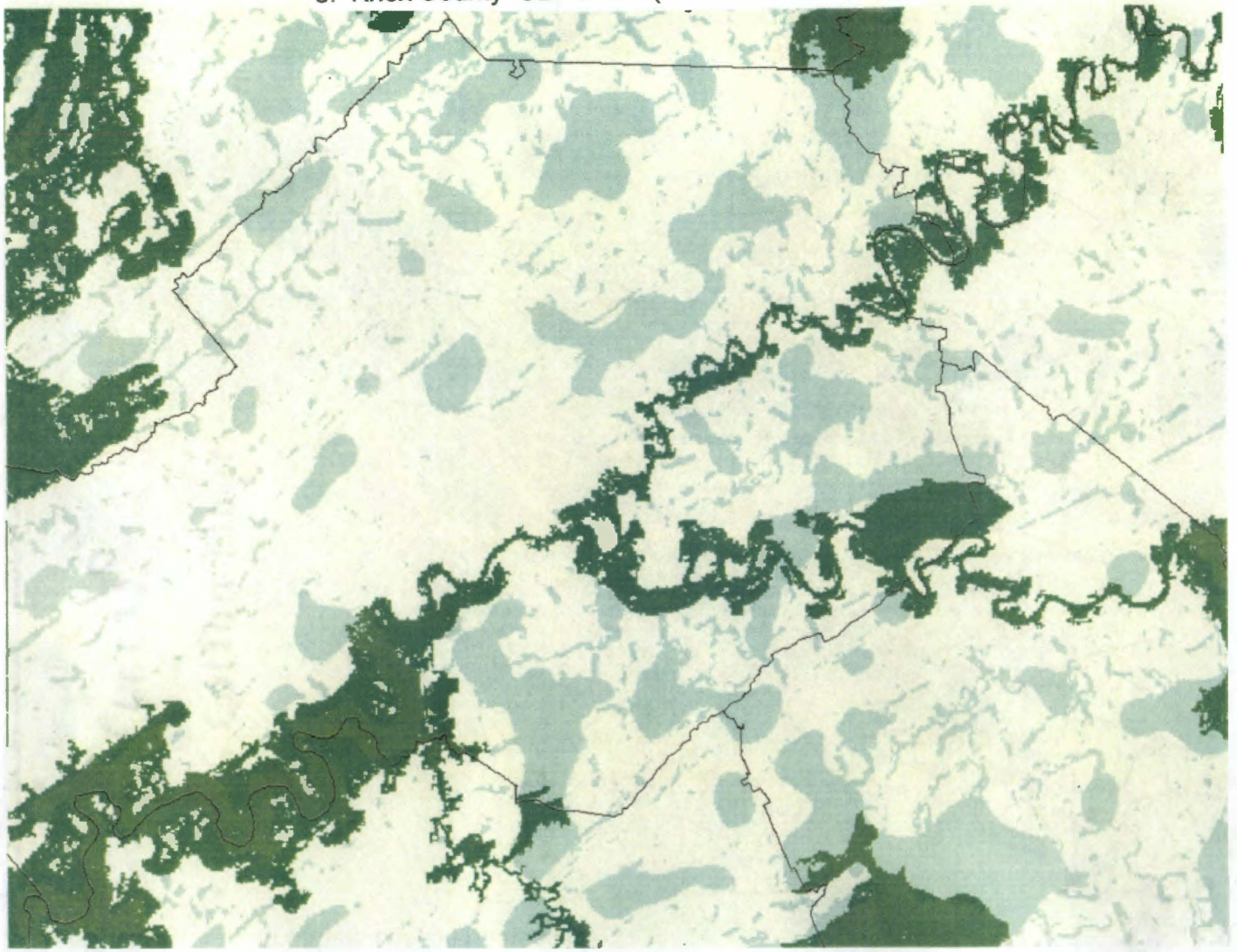
1. Nine County Region- SEF Detail (hubs and connectivity)



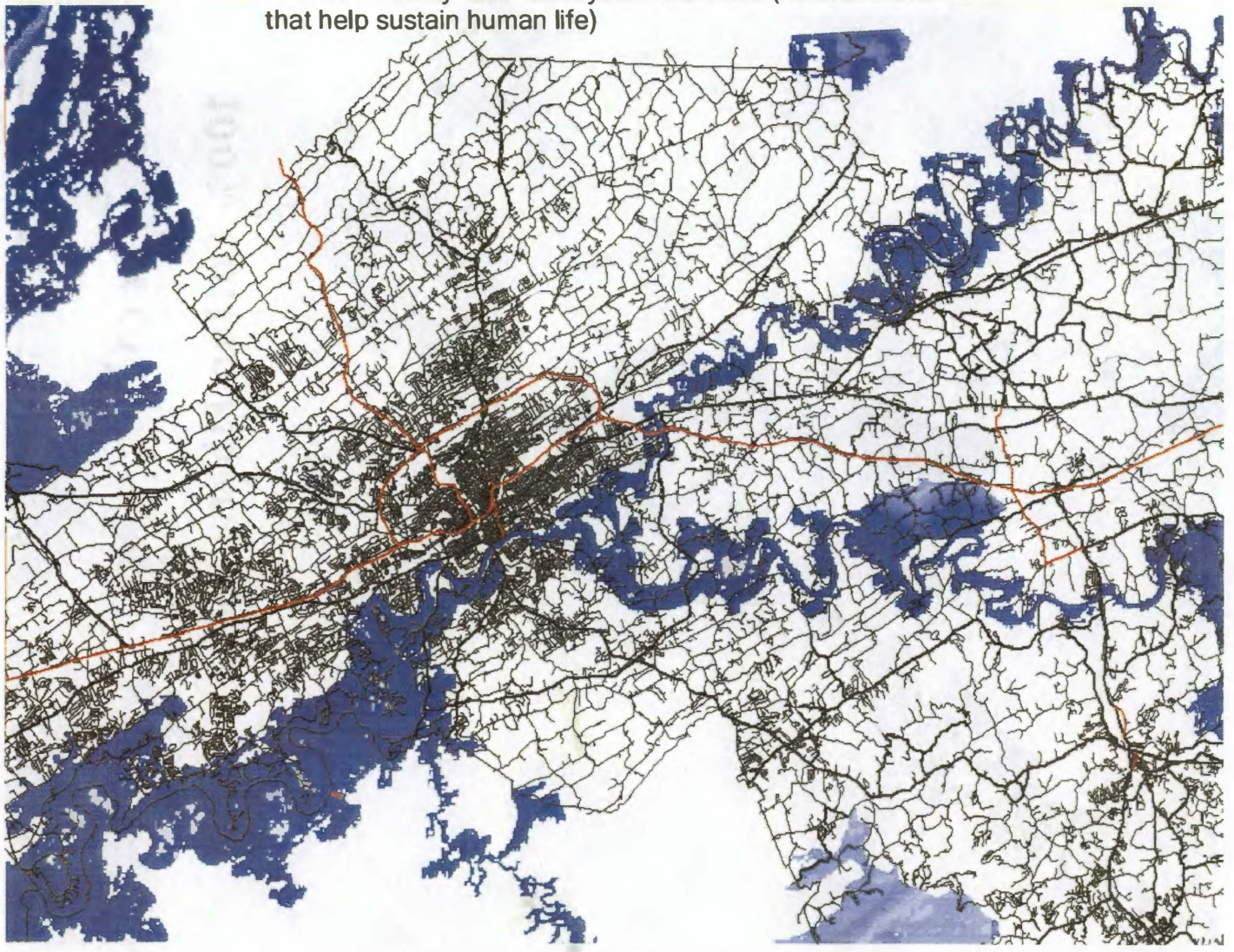
2. Nine County Region- Land Cover



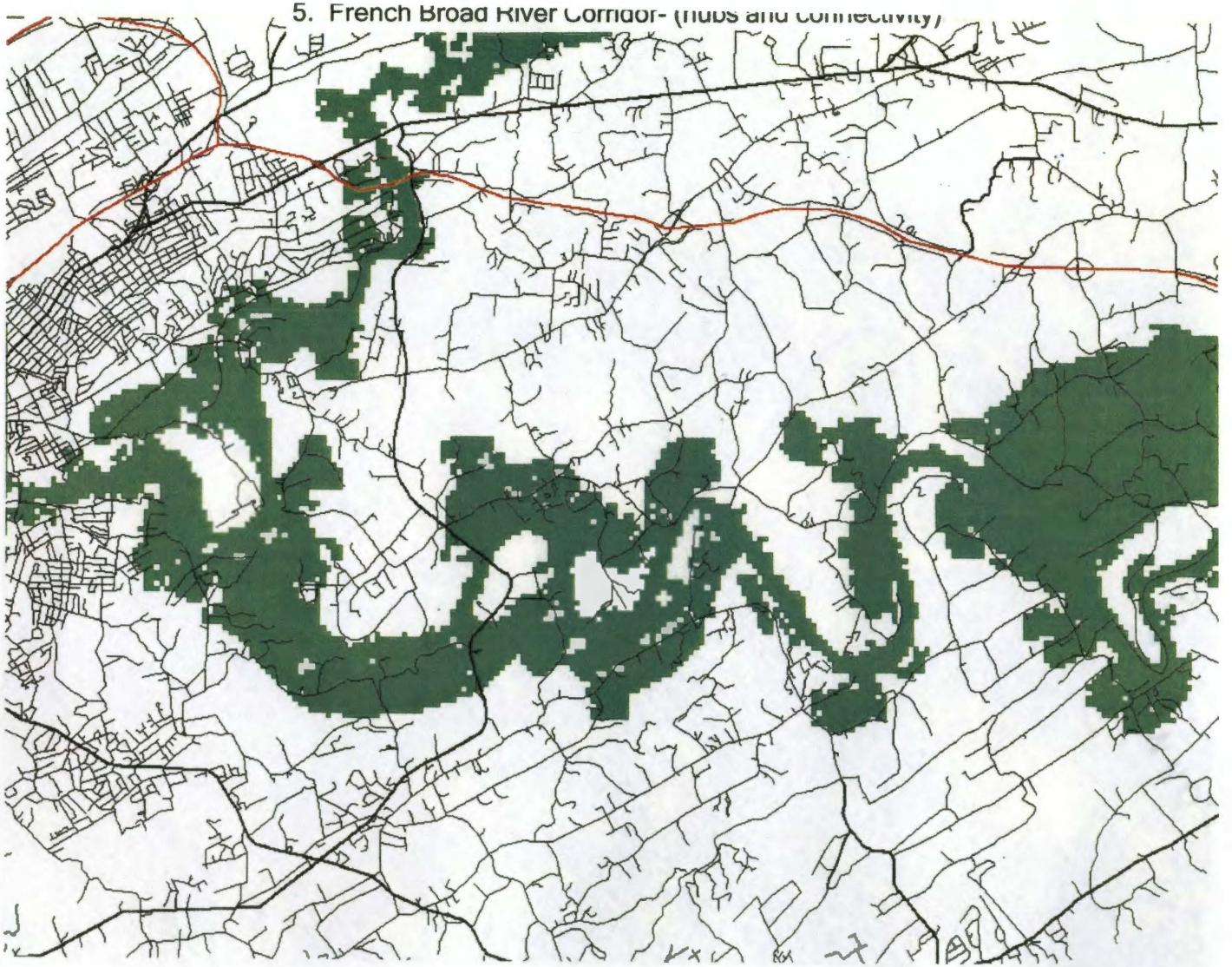
3. Knox County- SEP Detail (hubs and connectivity)



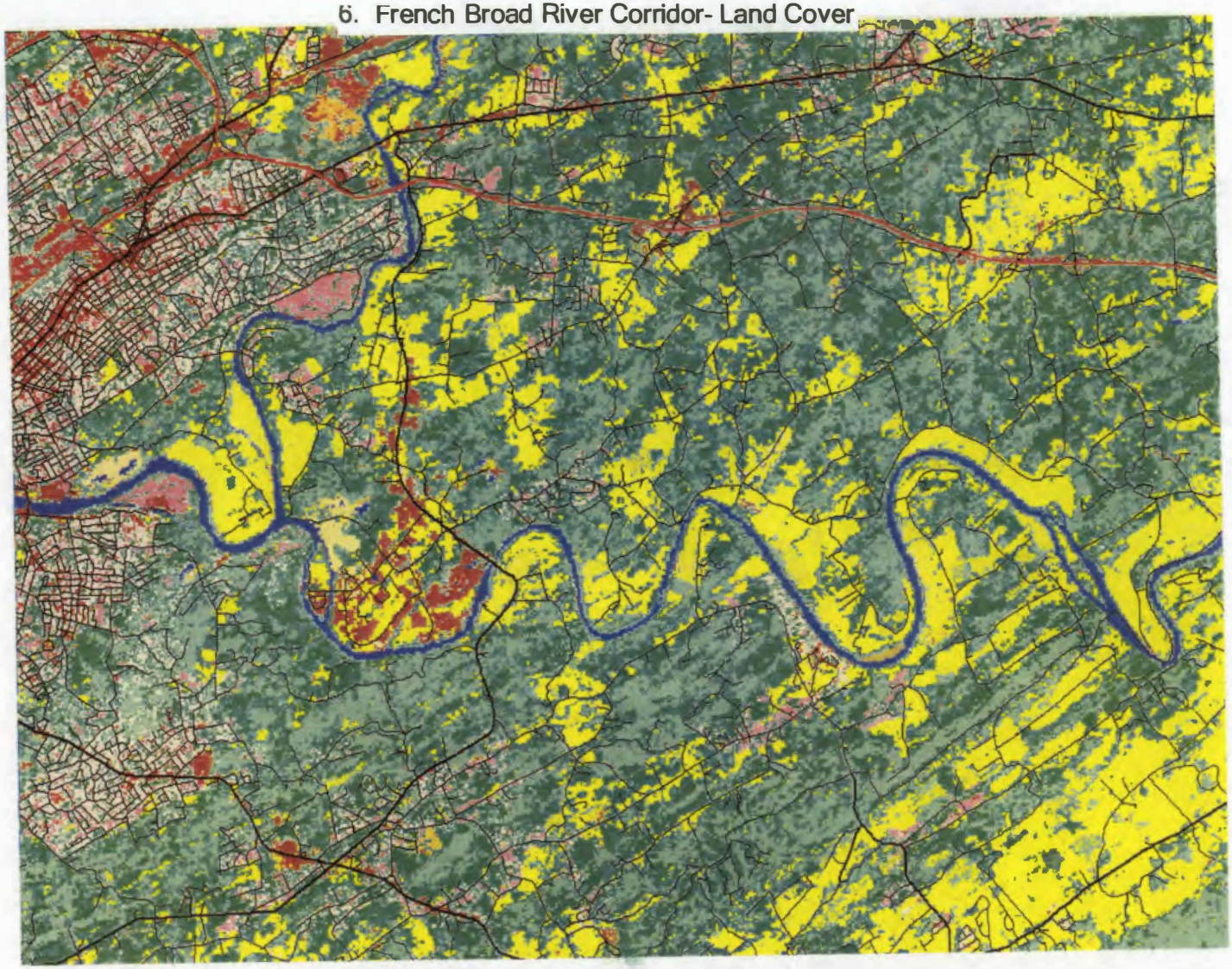
4. Knox County- SEF Ecosystem Services (natural areas that help sustain human life)



5. French Broad River Corridor- (hubs and connectivity)



6. French Broad River Corridor- Land Cover



VITA

Margaret Ann Ely was born in Baltimore, Maryland. She was raised in Rogersville, Tennessee and graduated from Cherokee Comprehensive High School. Margaret Ann then went to the University of Tennessee, Knoxville where she received her Bachelor of Science in Ornamental Horticulture and Landscape Design in May of 2002. She joined the Department of Urban and Regional Planning at the University of Tennessee, Knoxville in August 2002. During her studies in Planning, Margaret Ann worked on an assortment of community projects, ranging from neighborhood design to developing a sustainable eco-tourism plan to a participatory planning process for the Little River watershed. She will receive her Master of Science in Planning in December 2004.

Margaret Ann worked with the Community Partnership Center at the University of Tennessee as part of her assistantship with the Department of Planning. She also worked as a research assistant with Dr. Peine for the United States Geological Survey.